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SCIENCE

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LEGISLATION RELATING TO STANDARDS.*

ONE of the first official acts of the National Academy of Sciences, in the capacity of scientific adviser of the government, was the appointment, at the request of the Secretary of the Treasury, in 1863, the year in which the Academy received its charter, of a Committee on Coinage, Weights and Measures, which has continued to be a standing committee of the Academy. The report of this committee in 1866 was one of the effective forces in securing the passage of the most important, and, until recently, the only act of Congress constituting general legislation on the subject of weights and measures. In view of these facts, and on account of the remarkable progress towards unification of standards which has been made during the past few years, affecting in one way or another the whole civilized world, and especially in view of very recent activity and interest in this country, it seems proper to invite the attention of the Academy to a brief resumé of National legislation relating to weights and measures, from the founding of the National Government to the present moment. The task is rendered comparatively easy from the fact, for which metrologists can hardly be too thankful, that such legislation is extremely meager. It is a cause for sincere congratulation that in this respect, at least,

* Presented to the National Academy of Sciences at its April meeting.

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the powers conferred upon Congress by the Constitution of the United States have not hitherto been exercised in full. The importance of investing the sole power of regulating standards of weight and measure in the National government was recognized in the Articles of Confederation and expressed in the Constitution of the United States. The importance of a judicious exercise of that power was emphasized by Washington in his first message to Congress. By direction of Congress, the Secretary of State, Thomas Jefferson, made a report on July 15, 1790, in which he proposed an extremely interesting scheme founded on the length of a uniform rod which would make a single vibration per second when swinging from one extremity.

Jefferson fully appreciated the advantage of a decimal system of weights and measures, and the scheme proposed by him was as purely decimal as that of the Metric System, and in passing from the unit of length to that of volume and mass resembled it greatly. It may be truly said that full credit has never been accorded this, the most accomplished of the fathers of the Republic, for his nearly complete anticipation of the results of the labor of the most brilliant men of the most brilliant period of French science. Jefferson's report was referred to a committee in the Senate which, having learned of the movement toward uniformity in France and other European countries, reported that, in view of that movement, they considered it inexpedient to make any changes in the existing systems. Thus a little more than a hundred years ago the policy of 'waiting for the Metric System' was inaugurated and has practically continued to be the policy up to the present time. Occasional further references to the matter were made in reports, messages, bills offered, etc., during the last years of the last century, but no legislation resulted other than the inspection law of 1799, noted below. At least one

important consequence followed a reference to the desirability of action in the message of President Madison, sent to Congress on December 3, 1816. The paragraph relating to weights and measures was referred by the Senate to the Secretary of State, who was requested to prepare a report in full upon the subject, including such measures 'as may be proper to be adopted in the United States.' Four years later the Secretary, John Quincy Adams, transmitted to the Senate his famous report, which must always be regarded as a classic. For exhaustiveness, elaboration of detail and thoroughness of treatment no other document in any language relating to this subject is comparable with it. While it has been a storehouse of information and argument for all metrologists of later date, it did not result in any very decided action on the part of Congress. "Let them take the one or the other, according to the degree of their courage," Jefferson had said when, in 1792, he proposed two schemes, the one being a patching up of existing systems and the other a sweeping reform through the adoption of a decimal ratio throughout. While no one has appreciated the merits of the Metric System more completely than did Adams, and no one has ventured to praise it more highly, at the end of his splendid contribution to metrological science he reached the rather impotent conclusion that Congress ought to fix the existing systems with the partial uniformity of which they may be susceptible, excluding all innovations for the present, and that consultation with foreign nations should be begun, looking to the future establishment of universal and permanent uniformity. It is difficult to estimate what the lack of courage on the part of a great and far-seeing statesman has cost the people of the United States. The population of the whole country at that time did not exceed ten millions, and a change in standards of measure would have been comparatively easy.

The first act of Congress relating to the establishment of standards of weight and measure was that of May 19, 1828, in which a certain brass troy-pound weight which had been procured in London for the use of the mint at Philadelphia was declared to be the standard troy pound. This standard is well known to all metrologists. It was made by Capt. Kater in 1827, being a copy of the imperial troy pound taken from the House of Commons for that purpose. It is of brass, approximately pear-shaped, and its adjustment was accomplished by the addition of fine wires placed in a cavity in the upper part of the weight. Owing to this peculiarity of construction, it is impossible to know its density, and it has only historical value as a standard.

The next legislation by Congress was in the form of a resolution adopted in June, 1836, directing the Secretary of the Treasury to cause a complete set of all standards adopted by the Treasury Department for use in the custom houses and for other purposes, to be delivered to the Governor of each State of the Union. This was a useful measure, calculated and intended to give effect to the recommendation of Adams fifteen years earlier. It resulted in a tolerably complete uniformity of standards of length and mass throughout the Union.

A quarter of a century now passed without further National legislation on the subject. In the meantime, and especially towards the latter part of this period, the attention of many intelligent people in different parts of the country had been drawn to the great superiority of the Metric System of weights and measures, which had gone into extensive use in Europe, Mexico, Central and South America, and the enormous burden borne by English-speaking people in maintaining the customary standards had begun to make itself evident. As early as 1859, the legislature of New Hampshire urged

upon Congress the necessity for reform and the adoption of a decimal system. Maine followed in 1860 and Connecticut in 1861. In his first annual report as Secretary of the Treasury, Mr. Chase, in December, 1861, again brought the subject to the attention of Congress, and, as already stated, at his request the National Academy appointed its Committee for the consideration of the subject in 1863.

Although matters of greater moment occupied the time of Congress and filled the public mind during the five years following that of 1860, much progress was made towards a rational system of metrology, especially through the active interest of a few individuals and societies. For the final culmination of this agitation in the passage of the Metric Law of 1866, we are unquestionably indebted to Mr. John A. Kasson more than to any other one man. In 1861 Mr. Kasson was appointed First Assistant Postmaster-General by President Lincoln. In this office he became aware of the great embarrassment in the administration of international postal laws arising out of a lack of uniformity of units of weight and currency. Seeking relief therefrom, he originated and represented the United States in the International Postal Conference held in Paris in 1863, on the invitation of Mr. Seward, Secretary of State, which was, in fact, the forerunner of the International Postal Union, organized a little more than ten years later. One of the recommendations of the conference of 1863 was that the Metric System of weights be adopted for postal purposes. Mr. Kasson resigned the office which he held in the Postoffice Department in order to take his seat in Congress in December, 1863. Here his opportunities for advancing the interests of metrological reform were greatly enlarged. Having been appointed to serve on the Committee of Ways and Means and finding that that committee had within its jurisdiction the

subjects of 'Coinage, Weights and Measures,' he sought the creation of a separate committee, which should be exclusively charged with the consideration of these subjects and obtained from the House an order to that effect. Of this important committee, Mr. Kasson was made Chairman, and, beginning as it did, it has, during the thirty years of its existence as a standing committee of Congress, generally been favorable to metrological progress. During the next two or three years Mr. Kasson made an exhaustive study of the subject and did much to concentrate the growing interest in the Metric System and to guide the activity of various scientific bodies, commercial organizations, etc. In a private letter referring to this very important period in the history of legislation relating to standards, he speaks in highest praise of the invaluable assistance rendered by our Associate, Professor H. A. Newton, of Yale University, to whom was committed the task of preparing the tables of relation and conversion which accompanied the report of the committee and which form a part of the statute. In January, 1866, the Committee of the Academy on Coinage Weights and Measures made its report, and on May 17th Mr. Kasson submitted to Congress the report of the committee of the House of Representatives, unanimously recommending accompanying bills and resolutions, which, with a single exception, afterward were enacted into laws, and on July 28, 1866, the use of the Metric System was legalized by Act of Congress for the whole United States, being then and for many years the only system of weights and measures having the authority of National legislation. In the passage of this bill through the House, Mr. Kasson feared opposition; due, as he says, 'to the love of talk,' and to avoid furnishing a text for debate he tactfully declined to make a speech in favor of the passage of the bills and resolutions,

simply offering to answer any questions which might be asked. His policy was successful, and the proposed Act being only permissive and not obligatory in character, the whole matter was disposed of favorably in an hour or two. In the Senate the bill was referred to a special committee, of which Charles Sumner, who took a lively interest in the matter, was chairman. Sumner was generally eager to lead in reforms of this kind, and after mastering the material which was put into his hand he prepared an elaborate and scholarly speech in favor of the measure, which, however, he refrained from delivering, it is believed, on the advice and suggestion of Mr. Kasson. In this speech, which was afterwards printed, in a manner which was somewhat characteristic of the great champion of human liberty and the rights of man, he ignored in a great measure the work of the House Committee on Weights and Measures, if not, indeed, the action of the House, and was lauded by a portion of the public press as the successful first champion of this very important step towards a more advanced civilization. I have gone into these details concerning the Act of 1866 because of the real moment and significance of that Act. Although it produced little if any immediate effect in the way of a beginning in the actual use of the system, the attention of the general public was at once turned to it. Nearly all text-books on arithmetic published since that date have included a treatment of the Metric System, and instruction in its use has been given in thousands of schools throughout the country, thus, in a measure, preparing the way for its final exclusive use. In science quite universally, and in many arts, trades and professions, it has come into general use, to the end that at this moment most intelligent people know something of it. For this there is little doubt that we are largely indebted to the Act of 1866 and the agitation

which followed its passage. The general introduction of the system in the postoffices of the country was contemplated and provided for in Mr. Kasson's Act, and he had ready for future introduction a resolution providing for its compulsory use in the custom houses, thus greatly facilitating its general adoption in trade. His removal from Congress to the Diplomatic Corps of the United States prevented realization of his designs, but metrologists and the public at large should not fail to recognize the splendid services which he rendered in directing the legislation of thirty years ago.

The statutes are silent in the matter of weights and measures for more than a quarter of a century following the Act of 1866. The general trend of public sentiment during this period and the leaning of government authorities towards the final adoption of the Metric System is unmistakably shown, however, in the annual appropriations for the support of the International Bureau of Weights and Measures, to which we were committed as a nation by the International Convention of 1875.

The next legislation relating to standards was an Act, approved March 3, 1893, establishing a standard gauge for sheet and plate iron and steel. This measure is by no means an advance in practical metrology, its enactment being in response to the urgent demands of those actually engaged in the rolling of sheet metal. The influence of the Office of Weights and Measures prevented it from involving certain unscientific and physically impossible conditions, besides securing the use of metric units as well as the pound, foot and inch. It also secured the addition of a 'limit of error' or tolerance, a very important part of practical legislation in metrology, which has hitherto been almost, if not quite, absolutely neglected in this country.

Although not an Act of National legislation, a step of great importance was taken

on April 5, 1893, in the approval by the Secretary of the Treasury of a Bulletin issued by the Superintendent of Weights and Measures announcing the definitive adoption of the International Prototype Metre and Kilogramme as fundamental standards of length and mass and declaring that in the future the customary units, the yard and the pound, would be derived from them, in accordance with the Act of 1866. This put the government of the United States, as far as relates to the operations of all the Departments (with the single exception of the mint, for which the old troy pound remains a standard as explained above), on an international metric basis, all measures in ordinary use being derivatives of the metre and kilogramme.

The next step in metrological legislation was the Act of July 12, 1894, establishing a series of units for electrical measurement. This Act grew out of the recommendation of the International Electrical Congress held in Chicago in 1893. The units which it establishes are all founded on the centimetre, the gramme and the second, and it is distinctly a 'Metric' Act. For the successful management of this important Act, from the time of its introduction in the House, through its reference to the committees in both House and Senate and up to the time of its approval by the President, we are very largely indebted to Hon. Charles W. Stone, member of Congress from Pennsylvania, then a member and now Chairman of the House Committee on Coinage, Weights and Measures, who, by reason of his tastes and training, had an intelligent comprehension of the importance of a measure which was so technical in its character as to be nearly unintelligible to the ordinary legislator. Mr. Stone pressed the bill through its various stages with tact and influence to its final enactment as a law, at a time and under conditions when very little legislation of any kind was possible,

and the obligations under which he has placed metrologists is a matter worthy of record.

Up to the present date this Act completes the list of statutes relating to weights and measures, and it will be seen that in a hundred years only four laws fixing standards have been made. In 1828 the standard of the mint was fixed by law; in 1866 the Metric System was legalized; in 1893 a gauge for measuring sheet iron was established, and in 1894 the units for electrical measurement were defined.

This seems entirely inadequate to the needs of a great nation, and such a condition of things could never have continued had not the several States long ago exercised that authority which by the Constitution belongs to Congress, but which Congress has thus far practically ignored. For reasons already given, this condition is not one to cause regret. It leaves our National law makers to-day practically free from the influence of past legislation, which might be a serious obstacle in the way of following that course which a century of experience has now shown conclusively to be the only wise one.

History shows that marked advances of the character here referred to are usually brought about through the active, personal interest and enthusiasm of a very few men, often not more than one or two. It is true that they must be supported and reinforced by outside influence, but in a matter of this kind it will usually happen that not many members of either House or Senate will have the time or the interest to thoroughly inform themselves of the merits of a measure which does not immediately appeal to them. They depend largely on the few who are well informed, who have made a special study of the subject, and who by reason of their personal character and influence are accepted as authority. A general Act, however, changing either now or at some

fixed future time the whole system of metrology in daily and constant use is something which is likely to challenge opposition and to secure which it will be necessary to give the widest possible range to discussion and criticism.

Such an act is now under consideration by Congress. On December 26, 1895, Hon. D. M. Hurley, of New York, introduced a bill looking to the compulsory adoption of the Metric System within the next few years. It was considered with much care by the Committee on Coinage, Weights and Measures, to which it was referred, and on March 16th the Chairman of that Committee, Hon. Chas. Stone, made, by the unanimous direction of the Committee, an elaborate, interesting and valuable report, recommending the passage of a substitute for Mr. Hurley's bill, involving essentially the same principles, but differing from it somewhat as to details. Mr. Stone, as Chairman of the Committee, has championed the bill on the floor of the House with the same interest and skill that characterised his previous efforts in behalf of a scientific metrology. He has been efficiently seconded by Mr. Hurley and others, to the end that the friends of the measure have much confidence in its final success in the next session of Congress. No more important measure has been considered by Congress for many years and no opportunity to pass a law which will be for the great and lasting benefit of the whole of the people in so great a degree as this is likely to present itself for many years to come.

T. C. MENDENHALL.

NOTE.—The following are the Acts referred to above, except that of 1894, defining electric units, which has already been published in this journal:

Act of Congress of 1799, directing a semi-yearly comparison of weights and measures used in custom houses:

Number of gauge.	Approximate thickness in fractions of an inch.	Approximate thickness in decimal parts of an inch.	Approximate thickness in millimeters.	Weight per square foot in ounces avoirdupois.	Weight per square foot in pounds avoirdupois.	Weight per square foot in kilograms.	Weight per square meter in kilograms.	Weight per square meter in pounds avoirdupois.
0000000	1-2	.5	12.7	320	20.00	9.072	97.65	215.28
000000	15-32	.46875	11.90625	300	18.75	8.505	91.55	201.82
00000	7-16	.4375	11.1125	280	17.50	7.983	85.44	188.37
0000	13-32	.40625	10.31875	260	16.25	7.371	79.33	174.91
000	3-8	.375	9.525	240	15.	6.804	73.24	161.46
00	11-32	.34375	8.73125	220	13.75	6.237	67.13	148.00
0	5-16	.3125	7.9375	200	12.50	5.67	61.03	134.55
1	9-32	.28125	7.14375	180	11.25	5.103	54.93	121.09
2	17-64	.265625	6.746875	170	10.625	4.819	51.88	114.37
3	1-4	.25	6.35	160	10.	4.536	48.82	107.64
4	15-64	.234375	5.953125	150	9.375	4.252	45.77	100.91
5	7-32	.21875	5.55625	140	8.75	3.969	42.72	94.18
6	13-64	.203125	5.159375	130	8.125	3.685	39.67	87.45
7	3-16	.1875	4.7625	120	7.5	3.402	36.62	80.72
8	11-64	.171875	4.365625	110	6.875	3.118	33.57	74.00
9	5-32	.15625	3.96875	100	6.25	2.835	30.52	67.27
10	9-64	.140625	3.571875	90	5.625	2.552	27.46	60.55
11	1-8	.125	3.175	80	5.	2.268	24.41	53.82
12	7-64	.109375	2.778125	70	4.375	1.984	21.36	47.09
13	3-32	.09375	2.38125	60	3.75	1.701	18.31	40.36
14	5-64	.078125	1.984375	50	3.125	1.417	15.26	33.64
15	9-128	.0703125	1.7859375	45	2.8125	1.276	13.73	30.27
16	1-16	.0625	1.5875	40	2.5	1.134	12.21	26.91
17	9-160	.05625	1.42875	36	2.25	1.021	10.99	24.22
18	1-20	.05	1.27	32	2.	.9072	9.765	21.53
19	7-160	.04375	1.11125	28	1.75	.7938	8.544	18.84
20	3-80	.0375	.9525	24	1.50	.6804	7.324	16.15
21	11-320	.034375	.873125	22	1.375	.6237	6.713	14.80
22	1-32	.03125	.793750	20	1.25	.567	6.103	13.46
23	9-320	.028125	.714375	18	1.125	.5103	5.493	12.11
24	1-40	.025	.635	16	1.	.4536	4.882	10.76
25	7-320	.021875	.555625	14	.875	.3969	4.272	9.42
26	3-160	.01875	.47625	12	.75	.3402	3.662	8.07
27	11-640	.0171875	.4365625	11	.6875	.3119	3.357	7.40
28	1-64	.015625	.396875	10	.625	.2835	3.052	6.73
29	9-640	.0140625	.3571875	9	.5625	.2551	2.746	6.05
30	1-80	.0125	.3175	8	.5	.2268	2.441	5.38
31	7-640	.0109375	.2778125	7	.4375	.1984	2.136	4.71
32	13-1280	.01015625	.25796875	6½	.40625	.1843	1.983	4.37
33	3-320	.009375	.238125	6	.375	.1701	1.831	4.04
34	11-1280	.00859375	.21828125	5½	.34375	.1559	1.678	3.70
35	5-640	.0078125	.1984375	5	.3125	.1417	1.526	3.36
36	9-1280	.00703125	.17859375	4½	.28125	.1276	1.373	3.03
37	17-2560	.006640625	.168671875	4¼	.265625	.1205	1.297	2.87
38	1-160	.00625	.15875	4	.25	.1134	1.221	2.69

By a law of Congress, passed in 1799, 5th Congress, 2d Session, it was ordered that "the surveyor (of each port of the United States) shall, from time to time, and particularly on the first Monday in January and July in each year, examine and try the weights, measures and other instruments used in ascertaining the duties on imports, with standards to be provided by each collector, at the public expense, for that purpose; and when disagreements and errors are discovered, he shall report the same to the collector, and obey and execute such directions as he may receive

for the correction thereof, agreeably to the standards aforesaid."—(Statutes at Large, Vol. 1, page 643.)

Revised Statutes of the United States, May 19, 1828: "Sec. 3548. For the purpose of securing a due conformity in the weight of coins of the United States to the provision of this title, the brass troy pound weight procured by the Minister of the United States at London, in the year eighteen hundred and twenty-seven, for the use of the Mint and now in the custody of the Mint at Philadelphia, shall be the stand-

ard troy pound of the Mint of the United States, conformably to which the coinage thereof shall be regulated."

Resolved, by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he hereby is, directed to cause a complete set of all the weights and measures adopted as standards, and now either made, or in progress of manufacture, for the use of the several custom-houses, and for other purposes, to be delivered to the Governor of each State in the Union, or such person as he may appoint, for the use of the States respectively, to the end that a uniform standard of weights and measures may be established throughout the United States.

Approved June 14, 1836.

An Act to authorize the use of the Metric System of Weights and Measures, July 28, 1866:

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That from and after the passage of this Act it shall be lawful throughout the United States of America to employ the weights and measures of the Metric System, and no contract or dealing, or pleading in any court shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights and measures of the Metric System.

Sec. 2: And be it further enacted, That the tables in the schedule hereto annexed shall be recognized in the construction of contracts and in all legal proceedings, as establishing, in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the Metric System; and said tables may be lawfully used for computing, determining and expressing in customary weights and measures the weights of the Metric System," 1866.

An Act establishing a standard gauge for sheet and plate iron and steel:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of securing uniformity the following is established as the only standard gauge for sheet and plate iron and steel in the United States of America, namely:

[See table previous page.]

And on and after July first, eighteen hundred and ninety-three, the same and no other shall be used in determining duties and taxes levied by the United States of America on sheet and plate iron and steel. But this act shall not be construed to increase duties upon any articles which may be imported.

Sec. 2. That the Secretary of the Treasury is authorized and required to prepare suitable standards in accordance herewith.

Sec. 3. That in the practical use and application of the standard gauge hereby established a variation of two and one-half per cent., either way may be allowed.

Approved, March 3, 1893.

THE LACOE COLLECTION IN THE NATIONAL MUSEUM.

THE Lacoe Collection of Fossil Plants, the removal of which from Pittston, Pennsylvania, to Washington, has now been accomplished, is by far the largest and most valuable of its kind in America, and compares favorably with the richest paleobotanical collections in European museums.

Mr. R. D. Lacoe, who has so generously presented this magnificent collection to the Museum, is a leading business man of Pittston, who for twenty-five years has found diversion and outdoor occupation in collecting fossils, and whose enthusiasm in connection with his scientific and practical knowledge of mining has enabled him to bring together a most unique and valuable series of the Paleozoic plants of America.

His interest in the subject is a natural outgrowth of his taste for science, and has doubtless been stimulated by his environment, for he lives in the very heart of the northern Anthracite coal region. To this fact is also in large measure due his interest in paleontological research in general.

The collection contains nearly 100,000 specimens and was shipped in 315 cases, and is constantly being increased through the collecting agencies established by Mr. Lacoe in all the principal coal regions in the United States. The series illustrating the morphology of species and their geographical and geological distribution alone comprises over 17,000 specimens. It represents more thoroughly than any other collection the fossil flora of the Anthracite region of Pennsylvania. There are also especially good